The International Treaty
ON PLANT GENETIC RESOURCES FOR FOOD AND AGRICULTURE

Full Project Proposal Guidelines

Third Call for Proposals under the Benefit-sharing Fund

Deadline for submitting full project proposal: 5th of December 2014
at Treaty-Fund@fao.org and PGRFA-Treaty@fao.org

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PROJECT PROPOSAL COVER SHEET

Project No. _____ (*For Treaty use. Do not write anything here)*

Project Title: ____Addressing the challenges of climate change for sustainable food security in Turkey, Iran and Morocco, through the creation and dissemination of an international database to promote the use of wheat genetic resources and increase genetic gains._____

Project duration: 36 months_____

Target crops: *Triticum aestivum* L. (Bread Wheat)_____

Targeted developing country/ies: Turkey, Iran and Morocco_____

Other Contracting Party/ies involved: Kenya__

Project geographic extension (km²): 53,000_____

Total requested funding: 500,000 USD_____

Total co-funding: _____

Please select the type of project you are applying for:

☐ Single-country Immediate Action Project (Window 2)
☐ Multi-country Immediate Action Programme (Window 2)
☐ Single-country Co-development and Transfer of Technology project (Window 3)
☒ Multi-country Co-development and Transfer of Technology project (Window 3)

Applicant

Name of Organization: International Center of Maize and Wheat Improvement (CIMMYT)

Type of organization: International not-for-profit non governamental_____

Project Contact: (*name and position):* Marta da Silva Lopes, Wheat Physiologist, Scientist_____

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GENERAL REQUIREMENTS

These guidelines have been prepared to support applicants in the development of full project proposals. They describe the requirements that all applicants should adhere to when developing their full project proposal.

Please make sure you read these guidelines carefully before proceeding to fill in the Project Proposal Form. The full proposal should be prepared taking into account the thematic focus of the Third Call for Proposals, including in particular, the rationale, scope and expected outputs for each Window and sub-Window.

Project proposals must be clear and realistic on the problem to be addressed and objectives it tries to achieve. Project objectives have to fit in the thematic focus of the call and ultimately contribute to food security and poverty alleviation. Project objectives have to be logically interlinked with the planned activities, outputs and expected outcomes. The objectives and outputs have to be feasible in terms of duration and resources requested. The information to be provided in each section has to be focused and straightforward, qualitatively and quantitatively measurable in terms of what will be done, with what purpose, who, why and how will be involved in the activities to be implemented, who and how many will directly and indirectly benefit from the implementation of the project. A good full proposal will have a sound, clear and logically linked methodology of implementation and management.

The full project proposal should contain no more than fifteen (15) pages of text (Appendixes, table of contents and cover sheets excluded). The number of pages allocated to each section is a guide. The information required can be less but not more than the pages stipulated. All Appendixes should be duly filled in according to the provided guidelines as they form an integral part of the full project proposal. Project proposals lacking at least one Appendix, will be excluded from the selection process. The Appendixes will be provided to you in separate files together with the present document.

When submitting the full project proposal, additional attachments (endorsement letters, funding commitments, certification of the status of the organization) can be provided.

Please ensure that the project proposal and all attachments are legible in Times New Roman 12 and provided in two formats (pdf and word). Make sure the signature of the project coordinator is put on the signature page.

The project proposal, if approved for funding by the Bureau of the Sixth Session of the Governing Body, will form an integral part of the contractual agreement (Letter of Agreement) that will be signed with each applicant organization of the approved projects.

SECTION A: EXECUTIVE SUMMARY

1. Executive summary

This proposal aims to develop a combined multidisciplinary approach to transfer and implement technologies that will facilitate the development and adoption of wheat germplasm adapted to climate change (drought, heat and resistance to yellow rust) while ensuring sustainability and enhancing food security in Turkey, Iran and Morocco (more than 50000km^2). This proposal defines strategies to identify drought and heat adapted germplasm with resistance to yellow rust in two core collections (Collection 1 with breeding lines and varieties and Collection 2 with landraces) selected from wheat germplasm received from several genebanks through Standard Material Transfer Agreements (SMTAs): International Center of Maize and Wheat Improvement-CIMMYT, International Center for Agricultural Research in the Dry Areas-ICARDA, Turkish Seed Gene Bank, Aegean Agricultural Research Institute –AARI and from the Australian Winter Cereal Collection-AWCC). A total of 15000 accessions have been characterized, photographed and selected based on diversity and core collections assembled for this proposal. Challenges hindering the release of better-adapted varieties in the target region include: 1) Breeding lines and landrace collections stored in gene banks are poorly characterized and underexploited for adaptation to climate change. Technologies that can accelerate breeding are not implemented in the targeted region including: a) development of DNA markers for yellow rust resistance, drought and heat adaptation; b) unused genome-wide association studies (GWAS); c) most efficient strategy for including landraces in breeding unkown; 2) Transfer and implementation of technologies in previous point one scarce; 3) Limited information with regard to gene banks and traits associated with stored seeds. Phenotypic and genotypic data of genetic resources is scattered and unavailable to breeders in a unified database with a particular emphasis on drought and heat adapatation; 4) Reduced capacity building for more efficient use of plant genetic resources; 5) The socio-economic impact of the adoption of new wheat varieties adapted to drought and heat in the region remains unmeasured through modelling; 6) Lack of awareness about the relevance of diversity and the International Treaty through the conservation and use of wheat genetic resources. These six challenges have been identified as needs and priorities for the region and this proposal presents a work plan to fulfil those needs with the following six objectives and targeted outputs: 1) Accelerate breeding efficiency through: a) implementation of phenotyping and genotyping using high throughput technologies in Turkey, Iran and Morocco; b) identification of markers associated with drought and heat adaptive traits and yellow rust resistance through application of functional markers and GWAS; c) Testing a two-directional breeding approach of landraces x (crossing) breeding lines and breeding lines x landraces; 2) Transfer of technologies included in Objective 1 in the target area; 3) Create and disseminate a database of wheat genetic resources for traits relevant to climate change adaptation and sources of allelic adaptation to the target region. 4) Organize training sessions both informal and formal during the project to develop effective working relationships and promote the exchange and easy flow of information. 5) Share plans and priorities analyzed through modelling with government officials to help resource-poor farmers adapt to climate change, particularly those related to the adoption of better-adapted varieties; 6) Create awareness on the conservation and use of wheat genetic resources among different areas of expertise. Bring these expertise areas together to further enhance the number of resources and tools to better manage and use wheat genetic resources**.** If these objectives are achieved genbanks, breeders and scientists, government officials will benefit directly from this project whereas indirectly poor-resource famers and their families in a total of 40,000 people will ultimately benefit from this plan of action.

SECTION B: PROJECT DESCRIPTION AND CONTENTS

2.1. Problem definition

The Intergovernmental Panel on Climate Change (IPCC) reports that the warmest daily maximum temperature is projected to increase 4 to 7° C in the WANA region including Turkey, Iran and Morocco, the target region in this proposal (more than 5Mha). Additionally, mean annual soil moisture is projected to decrease in these countries whereas profitability of irrigated agriculture is expected to decline owing to increased pumping of groundwater and increased salinity risk of aquifers (IPCC, 2014). Climate change will affect global food security as shown by Schmidhuber and Tubielo (2007). The introduction of new wheat varieties adapted to low rainfall and terminal heat with increased water use efficiency is vital to mitigate the impact of these potential changes on food security while ensuring sustainability. Wheat breeders must overcome the significant hurdle of selecting for improved performance under drought and heat conditions. Challenges hindering the release of better-adapted varieties in the target region include: 1) Breeding lines and landrace collections stored in gene banks are poorly characterized at the phenotypic and genotypic levels and underexploited for adaptation to climate change. Information on potential parental lines for breeding is largely unknown. Technologies that can accelerate breeding are not implemented in the targeted region. They include: a) development of DNA markers for yellow rust resistance, drought and heat adaptation; b) unused genome-wide association studies (GWAS); c) lack of knowledge on the most efficient strategy for including landraces in breeding; 2) Transfer and implementation of technologies in previous point one scarce, scattered or nonexistent; 3) Limited information sharing within the target region, particularly with regard to gene banks and traits associated with stored seeds. Phenotypic and genotypic data of PGRFA is scattered and unavailable to breeders in a unified database; 4) Reduced capacity building for more efficient use of plant genetic resources; 5) The socio-economic impact of the adoption of new wheat varieties adapted to drought and heat in the region remains unmeasured through modeling; 6) Lack of awareness about the relevance of diversity and the International Treaty through the conservation and use of wheat genetic resources.

If these problems are resolved in the target region, breeding programs will have ready access to information relevant for parental selection, genetic diversity will increase and genetic gains will increase. Finally, an understanding of the socio-economic impact of the implementation of locally adapted varieties resilient to climate change will help policymakers to make better judgments on which wheat varieties to distribute to farmers and to improve their incomes.

2.2. Project objectives: Overall and specific objectives

Overall Objectives: To improve adaptation to climate change and enhance the food security of resource-poor farmers in Turkey, Iran and Morocco, by strengthening the sustainable management of plant genetic resources for food and agriculture through the extraction and dissemination of drought and heat adapted wheat genetic resources and to promote their global use; Specific are: 1) Accelerate breeding efficiency through: a) implementation of phenotyping and genotyping using high throughput technologies in Turkey, Iran and Morocco; b) identification of markers associated with drought and heat adaptive traits and yellow rust resistance through application of functional markers and GWAS; c) Testing a two-directional breeding approach of landraces x (crossing) breeding lines and breeding lines x landraces; 2) Transfer of technologies included in Objective 1 in the target area; 3) Create and disseminate a database of wheat genetic resources for traits relevant to climate change adaptation and sources of allelic adaptation to the target region. 4) Organize training sessions both informal and formal during the project to develop effective working relationships and promote the exchange and ready flow of information. 5) Share plans and priorities analyzed through modeling with government officials to help resource-poor farmers adapt to climate change, particularly those related to the adoption of better-adapted varieties; 6) Create awareness on the conservation and use of wheat

genetic resources among different areas of expertise. Bring these expertise areas together to further enhance the number of resources and tools to better manage and use wheat genetic resources**.**

2.3. Targeted outputs, activities and related methodology of implementation

Partner abbreviations: L (CIMMYT-Turkey), P1 (Bahri Dagdas Konya International Agricultural Research Institute-Turkey), P2 (IRTA-Lleida in Spain), P3 (Middle East Technical University in Turkey), P4 (CIMMYT-Iran), P5 (CIMMYT-Kenya), P6 (ICARDA-Genetic Resources-Morocco), P7 (ICARDA-Wheat Breeding-Morocco), P8 (Field Crops Research Institute in Turkey), P9 (Turkish Seed Gene Bank)

1) Collection of 240 breeding lines and varieties (Collection 1) and 300 landraces (Collection 2) successfully conserved and used for adaptation to climate change (drought and heat), resistance to yellow rust and associations with DNA markers.

A1.1) 240 breeding lines and varieties from breeding programs (Collection 1) analyzed, phenotyped, introduced and tested on the basis of promising adaptation to climate change (drought and heat adaptation) plus yellow rust resistance.

A1.1.1) Seed preparation of Collection 1 for phenotyping in Turkey, Iran and Morocco. Seed is being multiplied in Turkey (cycle 2014-2015) and will be prepared, packed and randomized (2 replications in an alpha-lattice design) by L and P1 in Turkey, starting in August 2015 and will be ready for distribution after 1 month in September 2015 for A1.1.2-A1.1.4. A spreadsheet with field books will be made available to each partner as excel files where the data will be collated and returned back to L for the activities A1.1.2-A1.1.4. **A1.1.2) Phenotyping of Collection 1 for adaptation to the target dry and warm areas of Turkey, Iran and Morocco.** Phenotyping conducted for 2 years starting in October 2015 to July 2016 and October 2016 to July 2017 growth seasons with completion expected in August 2017. The following traits will be measured: early vigor; heading; anthesis and physiological maturity dates; plant height; spectral reflectance of crop canopies; yield, yield components and water use efficiency (grain yield per unit rainfall). Standard protocols available at http://repository.cimmyt.org/xmlui/handle/10883/1288. Trials will be conducted in 4 m^2 plots for yield trials by P1 in Konya (two sites) and Turkish subcontractors: Trakya agriculture research institute (Edirne), Southern Anatolia Agricultural Research Institute (Diyarbakir), P4 in Iran will subcontract Dryland Agricultural Rsearch Institute (DARI) (Maragheh-Iran) and P7 in Rabat. Agronomic practices commonly implemented in all stations will be applied. Climatic data will be recorded daily in all sites. Finally, each partner will add all the data collected to the Excel field book provided (as explained in A1.1.1) and return it to L. **A.1.1.3) Phenotyping of Collection 1 for vernalization and photoperiod requirements and responses**. P2 (41º 40'N 0º20'E) and P7 (33º 37'N 6º 43'E), will test Collection 1 in the field for 2 years starting in October 2015 to July 2016 and October 2016 to July 2017 growth seasons with completion expected in August -2017. Field trials will be conducted in Lleida and Rabat under three planting dates (early, common in the area and late) to simulate different regimes of temperature/photoperiod and daily temperatures. Heading, anthesis and maturity dates and daily climatic data will be recorded. P7 will further conduct experiments to establish the photoperiod and vernalization requirements of Collection 1 and their earliness *per se* when these requirements are completely fulfilled using a growth chamber. **A.1.1.4) Phenotyping of Collection 1 for resistance to yellow rust and bunt (in Ankara -Turkey)**. Yellow rust score will be taken and coordinated by P8 for 2 years starting in October 2015 to July 2016 and October 2016 to July 2017 growth seasons with completion expected in August 2017. Seedling resistance testing in pots (only in Ankara), and in the field (1.5 m long rows) will be performed over two years in Haymana-Ankara. Artificial inoculation will be applied starting in March with mineral oil sprays (Soltrol 170). For scoring, the modified Cobb scale will be used.

A1.2) 300 different landraces (Collection 2) documented, evaluated and characterized (including analyzed and phenotyped) on the basis of promising adaptation to climate change (drought and heat adaptation plus yellow rust resistance).

A1.2.1) Seed preparation and distribution of Collection 2 for phenotyping in Turkey, Iran and Morocco. Seed preparation and distribution will be conducted as explained in A1.1.1 by L and P1 in Konya starting in August 2015 and be ready for distribution after one month in September 2015. The 300 Landraces in Collection 2 were selected based on genetic diversity and performance under low rainfall of around 15000 accessions previously tested in the region by L (see A1.2.3). **A1.2.2) Phenotyping of Collection 2** will be conducted similarly to Collection 1 as explained in activities A1.1.2 to A1.1.4 for 2 years for adaptation to the target dry and warm area of Turkey, Iran and Morocco, vernalization, photoperiod responses and requirements and yellow rust resistance. **A1.2.3) Delivery of project genetic resources products to the Turkish Seed Gene Bank**. L has previously evaluated wheat collections from Afghanistan, Turkey, Iran, China, Tajikistan, Azerbaijan, Georgia and Iraq (total of 15,000 Landraces and breeding lines) received from different gene banks of the Australian Winter Cereal Collection (AWCC), ICARDA, CIMMYT, AARI Izmir, Turkish Seed Gene Bank (P9) with SMTAs signed with all gene banks. These collections of 15,000 accessions containing landraces, breeding lines and varieties have been multiplied and purified by L in Ankara and Konya (2011-2012 growth cycle) and are considered PGRFA under development. Collections 1 and 2 described in A1.1.1 and A1.2.1 were selected from a geographically and genetically diverse group belonging to the 15,000 accessions. A backup of all selected and purified accessions will be made available to the Turkish Seed Gene Bank (P9). SMTAs will be developed by Sep-2015 between L and P9 for the above collections, 5 g of each of the 15,000 accessions will be packed by L, previously collected data and delivered to P9 and P6 in the same date.

A1.3) 10-20 useful alleles for adaptation to climate change (drought and heat), photoperiod, vernalization and earliness per se and yellow rust resistance discovered and exploited in the development of new varieties.

A1.3.1) Collection 1 and 2 (total 540 accessions) will be genotyped with the 35K SNP Axiom chip by Bristol Genomics Facility representative of Affymetrix as a paid service. Additionally, all germplasm will be genotyped for major functional genes related with heading date, plant height and resistance to yellow rust by P3 including: *Vrn-A1* (Yan et al. 2004)*; Vrn-B1*; *Vrn-D1* (Fu et al. 2005); *Ppd-A1* (Beales et al. 2007); *Ppd-B1* (Wilhelm et al. 2009), *Ppd-D1*, and (Diaz et al. 2012), *Rht-A1*(Tan et al. 2013), *Rht-B1*; *Rht-D1* (Ellis et al. 2002); *Rht8*; *Yr18*; *Yr46* and *Yr30*. All samples will be sent and collected in November 2015, processed in 1 year and completed by November 2016. DNA will be extracted by P3 in Turkey using the CTAB method modified according to CIMMYT laboratory protocols (http://repository.cimmyt.org/xmlui/handle/10883/3221) and PCR conditions used are described in the references after each gene(s) above and Primer combinations are described at http://www.cerealsdb.uk.net/cerealgenomics/CerealsDB/indexNEW.php. **A1.3.2) Alleles (new SNP markers) for traits indicated in A1.1.2 to A1.1.4 and in A1.2.2 (related to adaptation to drought and heat in Turkey, Iran and Morocco) identified through GWAS in Collections 1 and 2 by L, P1, P2, P3, P4 and P7**. Genome Wide Association Studies (GWAS) will be conducted using the most up to date methodologies (GAPIT, http://www.maizegenetics.net/#!gapit/cmkv) during the 3rd year of the project from August 2017 to Aug 2018 and completed by the end of the project. **A1.3.3) Major functional genes contributing to the response to photoperiod and vernalization requirements in the 540 samples (Collections 1 and 2) will be identified. GWAS will be conducted by L, P2, P3 and P7 using the phenotypic data collected for heading, anthesis and maturity date by all partners.** GWAS will be conducted using the most up to date methodologies (GAPIT) during the third year of the project from August 2017 to August 2018 and completed by the end of the project. **A1.3.4) Major functional markers associated with resistance to yellow rust in the**

target area tested with *Yr18, Yr46* and *Yr30* and new SNP candidates in Collections 1 and 2. GWAS will be conducted by L, P3, and P8 to determine whether or not functional markers play a role in yellow rust resistance in Turkey for Collections 1 and 2 and, if not, will determine the SNP candidates that better associate with yellow rust resistance. GWAS will be conducted using the most up to date methodologies (GAPIT) during the third year of the project from August 2017 to August 2018 and will be completed by the end of the project.

A1.4) 10 useful breeding populations developed for introgression and conservation of alleles responsible for adaptation to climate change (drought and heat).

A1.4.1) Crossing (following backcross-BC) landraces (pollen donor) drought and heat adapted with modern wheat varieties (five crosses). Breeding populations will be developed and selected by P1 and L. Crosses have already been conducted and backcross segregating populations will be available for selections in the third year of the project in the October 2017 to July 2018 season. P1 will organize annual field days with farmers and selection will be developed with the participation of the farmers who attended the field day. In parallel L and P1 will use a strategic trait based crossing approach where physiological traits (like heading date, plant height and biomass through spectral reflectance indexes) are used as tools for selection.

A1.4.2) Crossing (following backcross-BC) modern germplasm containing *Rht* genes and resistance to main diseases (pollen donor) with landraces (five crosses) following the same approaches described in A1.4.1; The final product (candidate variety) will not be concluded during the project timeline, but BCF2s will be evaluated and compared to provide guidelines on the best approach (A1.4.1 compared to A1.4.2).

2) Technologies for conservation and sustainable use of PGRFA (new wheat collection available for characterization, routine use of markers, application of GWAS and physiological trait-based breeding) co-developed by and/or transferred to Turkish and Iranian PGRFA institutions (Turkish Seed Gene Bank, Field Crop Research Institute in Ankara, Bahri Dagdas International Agricultural Research Institute in Konya, Karaj-SPII in Iran).

A2.1) 3 technologies: a) routine use of DNA markers in selection; b) application of GWAS; and c) physiological trait based breeding co-developed and transferred.

A2.1.1 Transfer the routine use of DNA markers in selection (functional and SNP markers defined below in A.3.1) This information will be generated in the second year of the project and completed by Aug 2017 by P3. **A2.1.2) Application of GWAS.** L and all partners involved in phenotyping and genotyping will conduct GWAS for the traits described above in Collections 1 and 2. This activity will start in the third year (August 2017) of the project and completion is anticipated by the end of the project. **A2.1.3) Application of physiological trait based breeding.** Physiological trait breeding will consider early vigor (with digital photography), grain yield, heading, anthesis, maturity dates, plant height, biomass measured with spectral reflectance indices, to identify outstanding families and lines during the breeding process to complement the eye of breeders and farmers in output 1.4) A1.4.1 and A1.4.2. Physiological trait based breeding will start during the third year of the project (August 2017 to August 2018) and will be completed by the end of the project by L and P1. BCF2s from A1.4.1 and A1.4.2 will be grown in Konya, Turkey, and screened for the physiological traits described above using standard protocols available at http://repository.cimmyt.org/xmlui/handle/10883/1288.

A2.2) At least 50 PGRFA institutions in Turkey, Iran and Morocco benefiting from improved access to technologies, like marker development for MAS, phenotypic and genotypic data available for parental selection in breeding programs and knowledge associated to adapted genetic material (to drought and heat in the target region). Information developed in this project (database, useful DNA markers, PGRFA and publications) will be distributed to PGRFA institutions available at: http://www.globalplanofaction.org/servlet/CDSServlet?status=ND1uZXR3b3JrcyY2PWVuJjMzPSomMzc9a29z. Using the contact names available via the above link, information will be

disseminated to increase the probability of more PGRFA institutions using the new technologies. **A2.3) Seed of more than 500 breeding lines, varieties and landraces tested or distributed.** Distribution of two collections described in Outputs 1 and 2 (completed by September 2015 by L and P1). The distribution of these two collections to all locations across Turkey and Iran will provide the unique opportunity for regional and national institutions to receive foreign germplasm and select potential parental lines adapted to local environments throughout the growth cycles.

3) A database created, disseminated and accessed by lead institutions on scientific, technical and environmental matters related to plant genetic resources for food and agriculture (breeding lines, varieties and landraces), including genotypic and phenotypic data and sources of germplasm with adaptation to drought and heat.

A3.1) A database, co-developed to support use of bioinformatics for exchange of information on PGRFA with useful properties (response to drought and heat and resistance to yellow rust) stored in gene banks. All phenotypic and genotypic data generated in Output 1 delivered to L will be shared with P6 for the development of a database. Development of the database will start in the first year and will continue throughout the project. It will be completed at least in experimental form by the end of the project in 2018. Database will be designed with MySQL. The database developed will be aligned with other Wheat databases (including those from Gene Banks where the genetic resources were originally stored) and contracting parties shall cooperate to develop and strengthen a GIS and the DivSeek initiative as proposed by the International Treaty instruments. **A3.2) "Passport" and associated genomic/genotypic (organism, biochemical, molecular) information systematized and disseminated.** L will share genotypic data generated in A1.3.1 with gene banks where SMTAs were signed (see A1.2.3) and containing original passport data, at the end of the project. **A3.3) Mechanisms to enrich gene bank data with phenotypic data put in place.** L will deliver and share phenotypic data generated in A1.1.1 to A1.1.4 and A1.2.1 to A1.2.2 and A1.2.3 at the end of the project, with gene banks where SMTAs have been signed. **A3.4) Standards and protocols for genotypic, phenotypic, environmental and meta data developed and disseminated.** All phenotyping protocols will be disseminated with training courses and sessions using the manual available at http://repository.cimmyt.org/xmlui/handle/10883/1288. Routine protocols for genotyping of functional markers will be made available by P3 also available at http://repository.cimmyt.org/xmlui/handle/10883/3221. This will be made available throughout the project coordinated by L.

4) Increased capacity of PGRFA institutions and researchers to conserve and manage PGRFA, like wheat breeding lines, varieties and landraces and information on their adaptation to drought and heat.

A4.1) 3 capacity development activities (e.g. training workshops, knowledge exchange sessions, etc.) organized. L will organize with P1, P2, P3, P4, P7 and P8 one training course "Physiological breeding in Wheat" in June 2016 in Konya, Turkey. Knowledge exchange sessions will be organized in the first two years with partners involved in phenotyping in Turkey, Iran and Morocco in November 2015 and November 2016. **A4.2) Links established with regional, national and international gene banks.** These links have already been covered in output 1.2) A1.2.3. This project will strongly advise on the conservation of wheat breeding products and landraces to all partners involved throughout the project. **A4.3) Links forged with research and development institutions regionally/ globally**. This project brings together a multidisciplinary team that includes Physiology (L), breeding (P1, P2, P4 and P6), socio-economics (P5), pathology (P7), biotechnology (P3), computer science (P6) and a gene bank (P9) and mostly, institutions are based in the target region of Turkey, Iran and Morocco. Strong linkages are expected to continue beyond the end of the project once the technologies are

efficiently applied in the target region. This activity will be achieved throughout the project. **A4.4) The capacity of at least 10 local and national institutions strengthened to conserve, manage, improve and disseminate plant genetic resources.** P1 and its web of locations (Konya, Eskisehir, Edirne and Diyarbakir), P3, P4 and its web of locations (Maragheh and Karaj), P7, P8 and P9 will be strengthened with tools (a database, DNA markers, GWAS and physiological trait-based breeding) to facilitate the identification of PGRFA adapted to climate change in Turkey, Iran and Morocco. The project will promote the exchange of PGRFA to other local and national institutions with wheat breeding programs. This activity will be achieved throughout the project. **A4.5) The capacity of 10 lead developing country institutions, 20 scientists and at least 100 breeders strengthened in the use of information management systems.** Through this project 7 leading developing country institutions in Turkey, Iran and Morocco (as described in A4.4.1) will develop new joint breeding tools throughout the entire project timeframe. At least three scientists in each of the 7 institutions will be involved in project activities and empowered with new breeding tools and knowledge. Finally, as a result of the project at least 100 breeders will be able to use the tools developed in this project. **A4.6) One fellowship granted for DNA fingerprinting (A.1.3.1)** for the 1st year of the project (starting August 2015 ending August 2016)**.**

5) Evidence-based plans and technological priorities (e.g. adoption of drought- and heat-adapted varieties and their impact in farmers fields) to help resource-poor farmers adapt to climate change, developed by a consortia of PGRFA institutions as building blocks for future policy development and investment.

A5.1) One new evidence-based study analyzing the negative consequences of climate change on food security in the targeted areas of Turkey, Iran and Morocco developed and disseminated. Calibrate representative wheat technologies for target countries to assess impact of climate change on wheat productivity by P5; Develop and use a dynamic bio-economic model to quantify impact of climate change on food security during the second year of the project (August 2016 to August 2017). **A5.2) Strategies developed for the diversification of local agricultural and food systems through the use of a wider range of locally adapted crops and varieties.** Future climate scenarios and spatial modeling will be applied by P5 to identify hot spots for decreased wheat production in Turkey, Iran and Morocco in an uncertain climate; Based on hot spot areas (decreased wheat production highly expected) from modeling (activity 5.1), develop targeting strategy for wheat technologies (for example, drought-tolerant varieties can be targeted in places where the future climate is projected to be drier) during the third year of the project (August 2017 to August 2018). **A5.3) Relevant information disseminated to policymakers.** A policy workshop to be organized by L and P5 in the target region to disseminate findings on better targeting of wheat technologies in an uncertain climate in August 2018. This workshop will stress the importance of implementing policies that can regulate and guarantee an appropriate distribution of adapted seeds to each region according to the results obtained in the modeling and characterization of different wheat accessions in the field.

6) Awareness on the International Treaty and values of PGRFA to meet future challenges raised at the regional, national and international levels.

A6.1) Awareness-raising, training materials and other information products (video, brochures, booklets, fact sheets, videos, websites, flash and PowerPoint presentations, etc.) created to support national, regional and subregional awareness-raising strategies. Power point presentations and brochures will be prepared for awareness raising sessions by L and P5 to be completed for training course (A4.1.1) in June 2016 and for a policy workshop in August 2018; **A6.2) 50 participants participating in awareness raising sessions.** Training course (A4.1.1) and Policy workshop (A6.3.1) organized within this project will integrate and disseminate the International Treaty and values of PGRFA to meet future challenges within the target region; **A6.3) Access to information on PGRFA and its value to meet climate**

challenges enhanced and made available. Training course (A4.1.1) and policy workshop (A4.3.1) organized as part of this project will integrate and disseminate the International Treaty and values of PGRFA to meet future challenges within the target region. Dissemination of a database will also provide the opportunity to thousands of people to become aware of the PGRFA conservation and use importance.

References

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2.4. Targeted PGRFA

Targeted PGRFA for the project: Wheat breeding lines, varieties and landraces from several genbanks including AWCC, ICARDA, CIMMYT, AARI-Izmir genbank and Ankara genbank, a total of 15,000 accesions were received through SMTAs. **Expected PGRFA resulting from the project**: seed multiplided in the field, purified and selected. Winter wheat core collections assembled through representative genetic diversity and response to low rainfall available to the scientific community. **Expected information resulting from the project:** basic agronomic descriptors (kernel size, grain yield, spike length, heading date, seed color and spike photographs) for 15,000 accessions shared with genbanks; Collections of breeding lines, varieties (Collection 1) and landraces (Collection 2) characterized in the field (for adaptation to low rainfall andterminal heat plus yellow rust resistance) and genotyped; Database with all data shared within the Global Information System infrastructure. Mesurable socio economic impact and benefit on farmers fields associated with the adoption of wheat varieties adapted to drought and heat.

2.5. Target groups and beneficiaries

Direct benefeciaries: 5 genbanks will receive phenotypic and genotypic data on shared accessions; 80 Breeders and Scientists (estimated 10% women; 90% man), but this number will rise if the information resulting from this project is used by scientists and breeders in the Great Plains and Pacific North-west (ME12, the same megaenvironment as in Turkey and Iran). Breeders and scientists will have information about adapted germplasm to climate change for crossing; 10 government officials from Ministry of Agriculture in Turkey and Iran (0.01% women; 99.99% man) will participate in workshops organized within the scope of the project and results of the project will provide a baseline for future decisions and policies. Project design was defined and created with active participation of Turkish and Iranian partners and activities agreed with all partners.

Indirect beneficiaries: 10,000 Poor-resource famers (52.3% women; 47.7% man) and their families in a total of 40,000 people. Dissemination of phenotypic data from low to moderate rainfall areas will provide easy access to potential parental lines with drought and heat adaptation and this will ultimately increase genetic gains and increase the probability of releasing better adapted varieties with higher yields in the region and increase incomes

of resource poor farmers in hot spot areas. Moreover, adoption of the most well adapted varieties and the assessment of its impact in the region will directly increase resource poor farmers incomes and their families.

2.6. Impact and impact pathways

2.6.1. Food security and poverty alleviation

Increased availability of food through increased grain yields (at least 10%) if better adapted varieties are adopted in the region; the availability of high yielding/resistant crop varieties (at least 10 or 20) with drought and heat adaptation available for adoption; locally adapted seed is distributed to farmers according to the region; better adapted wheat varieties will be made available for the region with increased diversification; expected 10% increase in farmer's incomes.

2.6.2. Adaptation to climate change and environmental sustainability

The availability of resilience and adaptation strategies through better management of PGRFA. The use of more water use efficient wheat varieties will promote sustainability of resources particularly water. Through this project, we will identify possible hot spots where wheat production is expected to decrease in a more evident way and strategies and options of PGRFA may need to change in the future for those hot spots. We will also determine the socio economic impact of using drought and heat adapted varieties in comparison to baseline wheat varieties in the region.

2.6.3. Scientific impact

The objective of this project in terms of scientific impact is to include national and regional programs on the development of new technologies and their application plus the capacity to develop scientifically sound analysis of the results. The project aims to transfer the already functional mechanics of hypothesis testing, analysis and decision making through scientifically sound results published in high impact scientific journals implemented in International Centers like CIMMYT and ICARDA and transfer this capacity to the national and regional programs. Through this project important opportunities for information exchange and technology transfer will be implemented among different disciplines: genbanks, computer scientists, physiologists, pathologists and biotechnologists together with the same objective. Linkages between disciplines will open new opportunities of collaborations and to increase scientific impact in the target region.

2.6.4. Capacity development and empowerment

Through the project, young scientists involved in marker use, database development, modelling, physiological trait based breeding will be involved in all the processes and will learn how to use them. At least around 18 young scientists will be selected with a strong sense of gender equality for opportunities, empowered and equipped with skills for the above technologies and how to bring them together for the purpose of PGRFA management, dissemination and use. Institutions will be linked and will be encouraged to continue the characterization of germplasm stored in local genbanks in the future to further expand the impact of this database to the scientific community. The project will provide equal opportunities to both women and man for capacity development and empowerment.

2.7. Relevance to national or regional priorities in its plans and programmes for PGRFA

The use of more water use efficient wheat varieties will promote sustainability of resources particularly water and this is aligned with the Turkish Ministry of Agriculture incentives and support of agricultural practices aiming at conserving soil structure and water to prevent erosion (http://www.tarim.gov.tr/Konular/Plant-Production/Field-Crops/CATAK-Project?Ziyaretci=Ciftci). Locally adapted seed identified and distributed to farmers according to the region and this is in line with the Turkish Ministry of Agriculture incentives to adopt certified seeds of varieties with higher genetic potential in proper regions through proper growing technologies (http://www.tarim.gov.tr/Konular/Plant-Production/Seed-Production?Ziyaretci=Ciftci). This project must encourage governamental officials to implement regulations that guarantee the use of well adapted varieties in the region by farmers (and avoid the use of varieties that may collapse in some regions for obvious reasons like spring wheat varieties sold to farmers in winter wheat areas). These measures if well implemented will contribute to increase farmers wheat production and their income. These activities are also in line with national priorities in Iran and Morocco.

SECTION C: OPERATIONS

3.1. Methodology of project implementation

Project management of all outputs and activities will be performed by the leading Institution CIMMYT-Turkey (L), promoting and encouraging for a constant and honest flow of communication with each partner to ensure that each step and activity of the project is achieved on time and with an acceptable quality standard. Management will be crucial to identify challenges during the project implementation process, create solutions and move forward. L will manage the project according to the following principles: **1) Managing Time**: Deadlines for tasks agreed and established with each partner at the beginning of each activity. L will ensure that tasks are completed on time according to Section B and Gantt chart. Specifically, L will monitor progress, deadlines and adjust schedules, report on the actual timeline, analyze and explain why some tasks proceeded much more quickly or much more slowly than expected; **2) Managing Money**: L will ensure that the costs remain within the budget, compile financial reports and statements, analyze definitive financial report. Specifically L and team will assign budgets to team members for specific tasks, determine costs for materials and tools, and encourage each partner to monitor cash flow, negotiate with suppliers, determine whether the original cost estimates are still accurate, adjust budgets and negotiate with customer and/or client concerning budget adjustments; **3) Managing Quality**: the project result must fulfill a number of quality requirements assigned to each partner at the beginning of the project with subsequent monitoring agreed and recorded in writing between L and partners throughout the project: phenotyping quality, experimental design, number of replications, soil quality and uniformity, status of equipment, appropriate timing for data collection, marker screening tested and in pilot assays, data curation, database development tested throughout the project to ensure quality and simplicity of use, and modeling results monitored. L will test the (intermediate) results, address any quality problems, confirm that the desired quality has been attained in the project, address any complaints (particularly in the follow-up phase); **4) Managing People**: L will direct partners, monitor human aspects through establishing direction, aligning partners by helping the project team to understand and believe in the final goal, motivating and inspiring by energizing people to overcome major obstacles and produce needed change by communicating, involving others in how to achieve the goals of the project, supporting through feedback, providing opportunities for coaching if needed, and recognizing and rewarding the successes; 5) **Managing information**: L will ensure through emails, video conferences and meetings with each partner that the right information is provided to the right person, particularly for interconnected activities within each output and to determine whether agreements have been met. L will write project reports.

3.2. Partnerships and collaboration arrangements

L (CIMMYT-Turkey, Global Wheat Program, Wheat Physiology) team: Marta da Silva Lopes (leader), Bahar Erdemel (financial officer), Handan Karatogma (Technician) and Ibrahim Ozturk (Technician). **Roles in the project**: coordinates the project, creates the environment for information and knowledge sharing, gives expertise in phenotyping technologies, field designs, GWAS and statistical analysis. **Capacities and expertise**: has more than 20 papers published in high impact journals. Has contributed to the development of a manual containing methodologies for field phenotyping and other book chapters. Has developed methodologies related with field phenotyping and has more than 5 years of experience in implementing and managing successfully on-going projects with developing countries at the national and regional levels (Mexico, Sudan, Egypt, Iran and Syria). Leads the winter wheat Physiology team in CIMMYT-Turkey for the past 3 years to implement

strategic trait based breeding activities in several locations (Konya, Diyarbakir, Edirne in Turkey and Maragheh in Iran) to increase wheat yields under low to moderate rainfall and terminal heat together with national and regional partners and breeders.

P1 (Bahri Dagdas Konya International Agricultural Research Institute), Emel Ozer (PhD), (Head of Breeding & Genetic Department), team members (Musa Turkoz, Gül Imriz and Rıfat Zafer Arisoy). **Roles in the project**: coordinating seed distribution (seed health laboratory available), field trials in Konya and phenotyping, coordinate phenotyping in Turkey through a web of subcontractors (Edirne and Diyarbakir), organize traning courses and field days. **Capacities and expertise**: Has more than 14 years of experience in field management and breeding. Provides services of seed preparation for distribution with a functional seed health laboratory. Conducts field days and organizes Physiology training courses every year with CIMMYT and ICARDA, has hundreds of visitors every year from all around the world particularly interested in the Drought Center.

P2 (IRTA-Lleida in Spain), Conxita Royo (Scientific Director, Senior Scientist and Wheat Breeder), Fanny Alvaro (Head of Program, Bread Wheat Breeder and Researcher), and Dolors Villegas (Durum Wheat Breeder and Researcher). **Roles in the project**: phenotyping, photoperiod and vernalization studies, analysis of GWAS, training and breeding expertise. **Capacities and Expertise**: IRTA is a state-owned Research Institute of the Catalan Government. IRTA's activities are concerned with scientific research and technology transfer and it functions under private sector law. The Field Crops Program holds the largest public bread and durum wheat breeding programs in Spain. In the last decade, 13 wheat varieties have been released, most of them already transferred to private seed companies, more than 40 research papers have been published and 6 PhD Thesis have been developed. Present research deals with the adaptation of wheat to Mediterranean environments, the identification and mapping of QTLs implied in drought resistance, the study of the genetic bases of crop phenology, the evaluation of past genetic gains, and the identification of Mediterranean landraces carrying favourable alleles for improving crop adaptation and grain quality. Has also large experience in activities for technology and innovation transfer in close relation with the public and private sectors.

P3 (Middle East Technical University in Turkey, Biotechnology, Biochemistry and Bioinformatics Graduate Programs), Mahinur S. Akkaya, current lab members; PhD candidates Ahmet Caglar Ozketen, Ayse Andac, Bayantes Dagvadorj, Adnan Yaramis. And MSc student Zemran Mustafa. **Roles in the project**: genotyping for functional genes and analysis of GWAS.**Capacities and expertise**: leads the biotechnology laboratory for more than 20 years, has experience in the application of molecular markers; DNA fingerprinting and genetic relationship of durum, bread wheat cultivars and wild types using SSRs and AFLP markers. Current activities include Pathogen-Plant interactions: investigating genes, miRNAs and pathogen effectors proteins involved disease formation and resistance in plants; DNA isolation from ancient wheat seeds (700BC-6000BC), PCR amplification and DNA sequence analysis of loci from ancient wheat to study wheat domestication. Development of new methods for SSR marker isolations. Functional genomics using oligonucleotide (DNA) differential display/screening microarray and proteomics technology methods to study disease resistance mechanism in wheat, barley and chickpea. Synthetic Biology in plants. Has more than 40 papers published in high impact scientific journals. She had graduated 39 students PhD and MSc students from various graduate programs of METU. Conducted many TUBITAK and COST projects.

P4 (CIMMYT-Iran) team: M. R. Jalal-Kamali (principal Scientist); Sub-contractors: Mozzafar Roustai in DARI, Goodarz Najafian, Mohsen Esmaeilzadeh Moghaddam and Farzad Afshari in Karaj-SPII, Iran. **Roles in the project**: coordinates phenotyping among national partners, delivers the data, analyses GWAS data for drought and heat adaptation and yellow rust together with L and other partners, analyses results of the impact and

benefit associated with the adoption of better adapted varieties in the region with P6 and L. **Capacities and expertise**: Works in CIMMYT for more than 7 years, provided training opportunities to more than 100 young Iranian scientists abroad, created a functional network of more than 12 Iranian institutions committed to deliver phenotypic data every year for germplasm generated by CIMMYT. Has more than 40 papers published in high impact journals. He worked for more than 32 years as wheat breeder and coordinator of cereal research programs in Iran at national level.

P5 (CIMMYT-Kenya-Socioeconomy Program-SEP), Sika Gbegbelegbe (Associate Scientist) and Senthold Asseng (Senior Crop Modeller, full Professor at the University of Florida-USA) will be hired as a consultant to assist on model development. **Roles in the project**: apply models to phenotypic data generated by the project and deliver the impact of climate change in the region and determines the socio economic impact of the adoption of drought and heat adapted wheat germplasm. **Capacities and expertise**: SEP program has calibrated and validated maize and wheat crop models for different Mega-Environments. For wheat, a baseline global wheat production has been simulated. The crop models have also been integrated with economic models to estimate the bio-economic impact of alternative futures. The integrated bio-economic models have been used to quantify the impact of weather extremes. Has published four papers in the past 3 years in high impact scientific journals.

P6 (ICARDA-Genetic Resources), Mohamed Fawzy Farag Nawar (Senior Documentation specialist, ICARDA genetic resources section), Ahmed Amri (Head of ICARDA genetic resources section, and deputy director Biodiversity and Integrated Gene Management program). **Roles in the project:** database development. **Capacities and expertise**: Worked for two years with Bioversity International on the development of Genesys, a global portal on genetic resources (genesys-pgr.org) the project was funded by the International treaty and the Global Crop Diversity Trust. Development of a new web-based genebank data management system (icarda.net/curators), and leading a grant from the Global Crop Diversity Trust to assess genebank documentation systems in 10 countries in CWANA region: "Combining phenotypic, genotypic and environmental data to optimize the use of genebanks holdings" with Wageningen university and in collaboration with CIMMYT.

P7 (ICARDA-Wheat breeding), Miguel Sanchez-Garcia (Bread Wheat Breeder - PDF), Quahir Sohail (Associate Winter Bread Wheat Breeder) Roles in the project: phenotyping, photoperiod and vernalization studies, analysis of GWAS and training. **Capacities and expertise:** ICARDA wheat breeding program has a long tradition of wheat germplasm and technology development and promotion in the CWANA region. Miguel Sanchez-Garcia and Quahir Sohail joined the ICARDA Bread Wheat Breeding program in 2013. They have authored more than 15 publications in high impact scientific journals, book chapters and international conferences and have strong background in wheat breeding and physiology, bread-making quality, genetic resources management and data analysis.

P8 (Field Crops Research Institute-Pathology in Ankara-Turkey), Zafer Mert and Kadir Akan. **Roles in the project**: screening for resistance to yellow rust of all collections. **Capacities and expertise**: up to date and functional screening for yellow rust, leaf rust and bunt among other diseases for thousands of germplasm every year to serve national and International breeding programs for more than 10 years.

P9 (Turkish Seed Gene Bank), Kursad Ozkek (Head of genbank) and Canan Yagci Tuzun (PhD). **Roles in the project**: storage of all accessions used in this project, provide feedback for requirements during database development. **Capacities and expertise**: Conservation, collection and molecular-morphological characterization of plant genetic resources, especially genetic diversity of crop plants, their wild relatives in the Turkish biodiversity through the following procedures: documentation, seed cleaning, drying and

packaging, seed physiology, cold storage rooms, characterization, production and herbarium.

3.3. Project management team

Coordinator: L (CIMMYT-Turkey). CIMMYT-Turkey has a long history of international collaboration with western and Central Asia countries. Nurseries are distributed every year to these regions successfully. CIMMYT-Turkey as both the scientific and administrative capacity to ensure proper deliver of germplasm and communication within Turkey and with Iran.

Project Experts: P2 (IRTA-Lleida Spain), P3 (Middle East Technical University in Turkey, Biotechnology, Biochemistry and Bioinformatics Program)-Mahinur Akkaya, P4 (CIMMYT-Iran) -M. R. Jalal-Kamali, P5 (CIMMYT-Kenya)- Sika Gbegbelegbe, P6 (ICARDA-Morocco-Genetic resources)- Mohamed Fawzy Farag Nawar; P7 (ICARDA-Wheat Breeding) Miguel Sancez-Garcia, P8 (Field Crops Research Institute-Pathology in Turkey)- Zafer Mert; P9 (Turkish Seed Gene Bank), Kursad Ozkek.

L will arrange bi-monthly phone-conferences with all experts to check for the status of activities, summarize concerns and challenges, and provide feedback and solutions. This will provide opportunities for open discussion and for the whole management team to provide feedback and solutions. L will directly visit all experts in Turkey and Iran for face-to-face discussions of challenges during project execution (in Turkey on a monthly basis and in Iran at least 2 times a year).

3.4. Sustainability

The project will develop a monitoring strategy to examine the progress of the interventions and also to document lessons learned. In addition to the monthly and annual reports developed by the project staff based upon a set of pre-identified progressive indicators (in the logframe Appendix 2), the project will organize semi-annual and annual meetings with the community to generate feedback, facilitate planning and promote people's participation. This will be a two-way approach for the achievement of effective results and ensure community ownership of the activities undertaken. Further, project visits will be undertaken on a regular basis as explained in 3.3. Maintenance of the database will be of relatively low cost after the end of the project and should be kept going with minimum requirements through ICARDA. The dissemination of the database should encourage other scientists to also contribute with new data. Follow up with Turkish and Iranian governmental officials on the implementation of new policies regarding seed distribution and ensuring that varieties distributed to farmers are adapted to their conditions.

SECTION D: APPENDIXES

APPENDIX 1: INFORMATION ON THE APPLICANT

Organization: International Center of Maize and Wheat Improvement

Type of organization: ***non-profit, non-governmental***

Address: CIMMYT Turkey PO Box 39 Emek, Ankara 06511, Turkey

P.O. Box: 39

Telephone Number: +903123448777

Fax Number: +903123270798

Country and city: Turkey, Ankara

Web page: http://www.cimmyt.org/en/

Contact Person

Mr ☐ Mrs ☒ Ms ☐

Name:_Marta __ Middle name: da Silva__ ____ Last name: Lopes___ __

Position: Scientist, Wheat Physiology

Address: CIMMYT Turkey PO Box 39 Emek, Ankara 06511, Turkey

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APPENDIX 2: LOGICAL FRAMEWORK

Project title: Addressing the challenges of climate change for sustainable food security in Turkey, Iran and Morocco, through the creation and dissemination of an international database to promote the use of wheat genetic resources and increase genetic gains				
	Intervention logic	**Indicators/targets**	**Sources and means of verification**	**Assumptions**
Impact	To contribute to the achievement of Millennium Development Goals 1 and 7: • *To eradicate extreme poverty and hunger* • *Ensure environmental sustainability*	Increased grain yields in farmer's fields (10%) with a concomitant increase in their incomes between Aug -2018 to Aug -2022 Increased yields through the use of more water use efficient varieties with less water spent per unit grain yield.	1. Ministry of Agriculture national production statistics 2. Ministry of Trade export statistics	1. No natural disaster will occur 2. Market prices will remain favourable. 3. Satisfactory marketing infrastructure will be in place. 4. Countries involved will be politically stable not causing general disturbances 5.The most well adapted wheat varieties for a certain region are

				distributed and sold
Outcome	To improve adaptation to climate change and enhance the food security of resource-poor farmers in selected developing countries, by strengthening the sustainable management of plant genetic resources for food and agriculture (PGRFA).	Drought and heat adapted varieties are adopted in the region	1. Surveys to farmers indicating the adoption of new varieties and reasons for their adoption	1.Certified drought and heat varieties are available to farmers 2. Satisfactory marketing infrastructure will be in place. 3. Agricultural diversification can be achieved when macro-economic conditions, producer incentives and government support policies are actually pointing in the same direction 4. The most well adapted wheat varieties for a certain region are distributed and sold 5. Farmers are correctly advised to buy the best wheat varieties for their region

Output 1	3) Collection of 240 breeding lines ar varieties (Collection 1) and 300 landrace (Collection 2) successfully conserved ar used for adaptation to climate chang (drought and heat), resistance to yellow ru and associations with DNA markers.	A1.1) 240 breeding lines and varieties from breeding programs (Collection 1) analyzed, phenotyped, introduced and tested on the basis of promising adaptation to climate change (drought and heat adaptation) plus yellow rust resistance. A1.2) 300 different landraces (Collection 2) documented, evaluated and characterized (including analyzed and phenotyped) on the basis of promising adaptation to climate change (drought and heat adaptation plus yellow rust resistance). A1.3) 10-20 useful alleles for adaptation to climate change (drought and heat), photoperiod, vernalization and earliness per se and yellow rust resistance discovered and exploited in the development of new varieties. A1.4) 10 useful breeding populations developed for introgression and conservation of alleles responsible for adaptation to climate change (drought and heat).	1.Data shared in a database available on the web 2. Scientific Publications 3.Monthly ongoing communication with project partners 4. Annual Reports	1. All growth seasons in all locations will be appropriate for crop growth. 2. No major pests and diseases will affect field trials
Output 2	2) Technologies for conservation and sustainable use of PGRFA (new wheat collection available for characterization, routine use of markers, application of GWAS and physiological trait-based	A2.1) 3 technologies: a) routine use of DNA markers in selection; b) application of GWAS; and c) physiological trait based breeding co-developed and transferred. A2.2) At least 50 PGRFA institutions in	1.Data shared in a database available in the web 2. Scientific	1. Staff keep same position throughout the project 2. All the implementing

	breeding) co-developed by and/or transferred to Turkish and Iranian PGRFA institutions (Turkish Seed Gene Bank, Field Crop Research Institute in Ankara, Bahri Dagdas International Agricultural Research Institute in Konya, Karaj-SPII in Iran)	Turkey, Iran and Morocco benefiting from improved access to technologies, like marker development for MAS, phenotypic and genotypic data available for parental selection in breeding programs and knowledge associated to adapted genetic material (to drought and heat in the target region). A2.3) Seed of more than 500 breeding lines, varieties and landraces tested or distributed.	Publications 3.Periodic interviews and surveys with staff members of PGRFA institutions and other Institutions 4.Monthly ongoing communication with project partners 5. Annual Reports	partners will keep their will and capacity to implement the project 3. Output 1 will deliver what it is supposed
Output 3	3) A database created, disseminated and accessed by lead institutions on scientific, technical and environmental matters related to plant genetic resources for food and agriculture (breeding lines, varieties and landraces), including genotypic and phenotypic data and sources of germplasm with adaptation to drought and heat.	A3.1) A database, co-developed to support use of bioinformatics for exchange of information on PGRFA with useful properties (response to drought and heat and resistance to yellow rust) stored in gene banks. A3.2) "Passport" and associated genomic/genotypic (organism, biochemical, molecular) information systematized and disseminated. A3.3) Mechanisms to enrich gene bank data with phenotypic data put in place. A3.4) Standards and protocols for genotypic, phenotypic, environmental and	1. Interview and surveys with staff members in genbanks 2. Data shared in a database available in the web 3.Monthly communication with project partners 4. Annual Reports	1. All the implementing partners will keep their will and capacity to implement the project 2. Output 2 will deliver what it is supposed

		meta data developed and disseminated.		
Output 4	4) Increased capacity of PGRFA institutions and researchers to conserve and manage PGRFA, like wheat breeding lines, varieties and landraces and information on their adaptation to drought and heat.	A4.1) 3 capacity development activities (e.g. training workshops, knowledge exchange sessions, etc.) organized. A4.2) Links established with regional, national and international gene banks. A4.3) Links forged with research and development institutions regionally/ globally. A4.4) The capacity of at least 10 local and national institutions strengthened to conserve, manage, improve and disseminate plant genetic resources. A4.5) The capacity of 10 lead developing country institutions, 20 scientists and at least 100 breeders strengthened in the use of information management systems. A4.6) One fellowship granted for DNA fingerprinting (A.1.3.1).	1.Periodic interviews with staff members of PGRFA institutions and other Institutions 2.Scientific publications 3.Annual reports	1.All the implementing partners will keep their will and capacity to implement the project
Output 5	5) Evidence-based plans and technological priorities (e.g. adoption of drought- and heat-adapted varieties and their impact in farmers fields) to help resource-poor farmers adapt to climate change, developed by a consortia of PGRFA institutions as building blocks for future policy development and investment.	A5.1) One new evidence-based study analyzing the negative consequences of climate change on food security in the targeted areas of Turkey, Iran and Morocco, developed and disseminated. A5.2) Strategies developed for the diversification of local agricultural and food systems through the use of a wider range of locally adapted crops and	1. Scientific publications 2. A Policy workshop organized and interviews with participants 3. Interviews with farmers	1. Outputs 1 to 3 will deliver what it is supposed. 2. Country policy makers will be open to receive information generated by the project 3. The most well

		varieties. A5.3) Relevant information disseminated to policymakers.	4. Final report	adapted wheat varieties for a certain region are distributed and sold
Output 6	Awareness on the International Treaty and values of PGRFA to meet future challenges raised at the regional, national and international levels.	A6.1) Awareness-raising, training materials and other information products (video, brochures, booklets, fact sheets, videos, websites, flash and PowerPoint presentations, etc.) created to support national, regional and subregional awareness-raising strategies. A6.2) 50 participants participating in awareness raising sessions. A6.3) Access to information on PGRFA and its value to meet climate challenges enhanced and made available.	1.Surveys to participants about gained knowledge and particularly to the use and access of PGRFA and its value	1.All the implementing partners will keep their will and capacity to implement the project

APPENDIX 3: WORK PLAN (Gantt Chart)

Project title: Addressing the challenges of climate change for sustainable food security in Turkey, Iran and Morocco, through the creation and dissemination of an international database to promote the use of wheat genetic resources and increase genetic gains

		1st Year						2nd Year						3rd Year						4th Year					
		Months						Months						Months											
	Activity	2	4	6	8	10	12	2	4	6	8	10	12	2	4	6	8	10	12	2	4	6	8	10	12
	OUTPUT 1(Phenotyping/Genotyping/Breeding populations)																								
	Activity 1.1 240 breeding lines and varieties...					X	X	X	X	X	X	X	X	X	X	X	X							X	X
	Activity 1.2 300 different landraces ...					X	X	X	X	X	X	X	X	X	X	X	X							X	X
	Activity 1.3 10-20 useful alleles...													X	X	X	X	X	X						
	Activity 1.4 10 useful breeding populations					X	X	X	X	X	X	X	X	X	X	X	X	X	X					X	X
	OUTPUT 2 (Technology Transfer)																								
	Activity 2.1 3 technologies...	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Activity 2.2 At least 50 PGRFA institutions	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Activity 2.3 Seed of more than 500 breeding...	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	OUTPUT 3 (Database Development)																								
	Activity 3.1A database, co-developed...	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

	Activity 3.2 'Passport' and associated genomic...													X	X	X	X	X	X					
	Activity 3.3 Mechanisms to enrich gene bank...													X	X	X	X	X	X					
	Activity 3.4 Standards and protocols for...													X	X	X	X	X	X					
	OUTPUT 4 (Capacity Building and linkages forged between partners and institutions)																							
	Activity 4.1 3 Capacity development...	X				X		X		X										X			X	
	Activity 4.2 Links established...	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Activity 4.3 Links forged....	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Activity 4.4 The capacity of 10 local...	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Activity 4.5 The capacity of 10 lead...	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Activity 4.6 One fellowship...	X	X	X	X	X	X													X	X	X	X	X	X
	OUTPUT 5 (Modelling socio economic impact of adoption of better adapted varieties)																							
	Activity 5.1 One new evidence-based...							X	X	X	X	X	X											
	Activity 5.2 Strategies developed for the diversification...													X	X	X	X	X	X					
	Activity 5.3 Relevant information ...																		X					
	OUTPUT 6 (Disseminate awareness of the Treaty)																							
	Activity 6.1 Awareness-raising...					X													X				X	
	Activity 6.2 50 participants...					X													X				X	
	Activity 6.3Access to information on PGRFA...					X													X				X	

Appendix 4- Budget

Staff		**collaborator**	**Unit**	**Quantity**	**Unit Cost**	**Total Cost**
				(no.of units)	**USD**	**USD**
Full time staff						
	L-Project coordinator (10%)	L	person-month	36	1800	64,800
	L-Field officer (30%)	L	person-month	36	456	16,416
	L-Field Technician (30 %)	L	person-month	36	400.5	14,418
Collaboration Part time staff						
	P1-Field workers	P1	person-day	50	40	2,000
	P2 - Coordinator	P2	person-month	1	6,502.71	6,502.71
	Wheat researcher	P2	person-month	1	4,614.35	4,614.35
	Field and lab officer	P2	person-month	0.7	3,558.07	2,490.65
	Field and lab technician	P2	person-month	1.5	2587.42	3,881.12
	P5-Bio-economic modeler	P5	person-day	45	300	13,500.00
	P6-Senior genebanks documentation specialist	P6	person-day	50	600	30,000.00
	P6-Software developer	P6	person-day	80	200	16,000.00
	P6-web designer	P6	person-month	60	300	18,000.00
	P7- Field research technician (10%)	P7	person-month	24	200	4,800.00
	P7- Growth chamber technician (Post-Graduate student)	P7	person-month	24	400	9,600.00
	P8-Pathology Team	P8	person-month	20	310	6,200.00
Consultants						
	P5-Expert on crop modeling	P5	person-month	45	450	20,250.00
Subtotal: Staff						233,472.84

Notes:

Travel			**Unit**	**Quantity**	**Unit Cost**	**Total Cost**
				(no.of units)	**USD**	**USD**
Local Travel						
Konya - Site 1 and 2						
	Duration (3 persons x1days x 10 trips)	L	person-day	30		
	Travel (3 persons)	L	round-	10	90	900

			trip			
	Daily Subsistence Allowance (DSA)	L	DSA	30	100	3,000
Diyarbakir						
	Duration (2 persons x1days x 4 trips)	L	person-day	8		
	Travel (2 persons)	L	round-trip	4	100	400
	Daily Subsistence Allowance (DSA)	L	DSA	8	100	800
Haymana-Site 1						
	Duration (3 persons x 3 days x 10 trips)	P8	person-day	90		
	Travel (3persons)	P8	round-trip	10	60	600
	Daily Subsistence Allowance (DSA)	P8	DSA	90	30	2,700
Rabat - Site 1 (Marchouch)		P7				
	Duration (2 persons 1 day 30 trips)	P7	person-day	60		
	Travel (2 persons)	P7	round-trip	30	50	1,500.00
	Daily Subsistence Allowance (DSA)	P7	DSA	60		
Iran-Maragheh						
	Duration (3 persons x 2 days x 2 trips)	P4	person-day	12		
	Travel (3 persons)	P4	round-trip	12	60	720.00
	Daily Subsistence Allowance (DSA)	P4	DSA	12	90	1,080.00
Gimenells (Lleida)						
	Duration (2 persons x 1 days x 3 trips)	P2	person-day	6		
	Travel (2 persons)	P2	round-trip	6	60	360.00
	Daily Subsistence Allowance (DSA)	P2	DSA	6	90	540.00
Subtotal: Local Travel						12,600.00
Regional/International Travel						
Teharan(Iran)-Ankara (Turkey						
	Duration (2 persons x 3 days x 2 trip)	P4	person-day	3		
	Travel	P4	round-trip	2	600	1,200.00
	Daily expense allowance	P4	person-day	3	130	390.00
Ankara (Turkey)-Rabat (Morocco)						
	Duration (3 persons x 3 days x 1 trip)	L,P1,P8 *	person-day	9		
	Travel	L,P1,P8 *	round-trip	3	900	2,700.00
	Daily expense allowance	L,P1,P8 *	person-day	9	130	1,170.00
Gainesville (USA)		P5	round-	1		

- Ankara (Turkey)			trip			
	Duration (1 persons x 13 days x 1 trip)	P5	person-day	13		
	Travel	P5	round-trip	1	2500	2,500.00
	Daily expense allowance [a/]	P5	person-day	13	130	1,690.00
Rabat (Morocco) - Ankara (Turkey)		P6, P7*	round-trip	2		
	Duration (2 persons x 4 days x 1 trip)	P6, P7*	person-day	8		
	Travel	P6, P7*	round-trip	2	900	1,800.00
	Daily expense allowance	P6, P7*	person-day	8	130	1,040.00
Lleida (Spain) - Ankara (Turkey)		P2	round-trip	1		
	Duration (1 person x 3 days x 1 trip)	P2	person-day	4		
	Travel	P2	round-trip	1	600	600.00
	Daily expense allowance	P2	person-day	3	130	390.00
Lleida (Spain) - Rabat (Morocco)		P2	round-trip	1		
	Duration (1 person x 3 days x 1 trip)	P2	person-day	7		
	Travel	P2	round-trip	1	500	500.00
	Daily expense allowance	P2	person-day	3	130	390.00
Subtotal: Regional/International Travel						14,370.00
Subtotal: Travel						26,970.00

Notes: * AMOUNT DIVIDED BY INDICATED PARTNERS

Training and Workshops			**Unit**	**Quantity**	**Unit Cost**	**Total Cost**
				(no.of units)	**USD**	**USD**
Workshops A						
Training						
	2 students x 3 weeks x training molecular breeding Module in Mexico	P3	training course participation	2	3500	6,000
	traveling to Mexico for training course	P3	2	2	1400	2,400
Training Course Physiology						
	Local Travel (20 persons x 1 workshops)	P1	round-	20	10	200

			trip			
	Food (lunch and tea breaks) and accommodation	P1	person-day	60	80	4,800
	Venue	P1	day	30	20	600
	Materials	P1	per person	30	50	1,500
Workshop Policies/Modelling						
	Local Travel (10 persons x 1 workshops)	P1	round-trip	10	10	100
	Food (lunch and tea breaks) and accommodation	P1	person-day	10	100	1,000
	Venue	P1	day	1	100	100
	Materials	P1	per person	10	50	500
Subtotal: Training and Workshops						17,200

Notes:

Materials and/or Equipment			**Unit**	**Quantity**	**Unit Cost**	**Total Cost**
				(no.of units)	**USD**	**USD**
	Tags for plot identification, bags	L	piece	30000	0.05	1,500.00
	Tags for plot identification, bags	P1	piece	3000	0.05	150.00
	Tags for plot identification, bags	P2	piece	2800	0.05	140.00
	NPK and micronutrients	P2	1Kg	1	100	100.00
	Herbicide	P2	1Kg	1	100	100.00
	Fungicide	P2	1Kg	1	100	100.00
	Seed Paper Envelopes	P7	piece	7000	0.05	350.00
	Plastic seed bags	P7	piece	2400	0.30	720.00
	Field Labels	P7	piece	10000	0	500.00
	Pots	P7	piece	1000	1	1,000.00
	Seed trays	P7	piece	500	0.2	100.00
	Soil	P7	m3	15	50	750.00
	soil	P8	m3	50	50	2,500.00
	inoculation machine	P8	piece	4	250	1,000.00
	Chemicals (for 12 months)	P8	lt	1000	2.5	2,500.00
	PC	P9	piece	1	1800	1,800.00
	Color laser printer	P	piec	1	198.	198.1

		9	e		18	8
	Scales (200-2000 g)	P9	piece	1	385	385.00
	PreScales (0.001-200 g)	P9	piece	1	462	462.00
	Long term seed storage bags	P9	piece	6000	0	2,280.00
	Chemicals	P9	piece	1	800	800.00
	Threshing machine	P9	piece	1	4,266	4,266
Subtotal: Materials and/or Equipment						21,701.18

Notes:

Logistical Support (12 months)			**Unit**	**Quantity**	**Unit Cost**	**Total Cost**
				(no.of units)	**USD**	**USD**
	Fuel	P1	litres	1,440	0.65	1,872.00
	Visas	L	person	10	100	1,000
	Fuel	L	lt	1000	2.5	2,500
	Import permits and seed examination	L	shipments	4	100	400
	Seed Shipments	L	shipments	4	750	3,000
	Administrative expenses	L	year	3	1000	3,000.00
	CGIAR(2%)	L				10,000.00
Subtotal: Logistical Support						21,772.00

Notes:

OTHER COSTS

Field activities			**Unit**	**Quantity (no.of units)**	**Unit Cost USD**	**Total Cost USD**
	Land Rental and field work	P4	ha	4	4200	16,800.00
		P2	ha	0.7	2500	1,750.00
		P1	ha	4	6500	26,000.00
		P7	ha	4	3800	15,200.00
Growth chamber						
	Running cost and maintenance (light tubes, AC, irrigation, cleaning, etc.)	P7	piece	1	16000	16,000.00
Glasshouse activities						
	Glasshouse rental	P8	cost per month	20	175	3,500.00
Subtotal: Field Activities						79,250.00

Notes:

Community Works			**Unit**	**Quantity (no.of units)**	**Unit Cost USD**	**Total Cost USD**
	Field Day in Konya	P1	day	1	2083	2,083.00
Subtotal: Community works						2,083.00

Notes:

Subcontracts			**Unit**	**Quantity (no.of units)**	**Unit Cost USD**	**Total Cost USD**
	Southern Anatolia Agricultural Research Institute (Diyarbakir-Turkey)	L	field trials	4	2125	8,500
	DNA extraction, shipment	L	sample	700	3.572	2,500
	Genotyping Vrn (4), Ppd (4), Rht (2), Yr(2)	L	sample	700	10	7,000
	35K SNP chip	L	sample	700	46	32,200

Subtotal: Subcontracts						50,200

Notes:

Visibility Plan			**Unit**	**Quantity (no.of units)**	**Unit Cost USD**	**Total Cost USD**
	Hosting service	P6	annual fees	3	400	1,200.00
	Domain name	P6	annual fees	10	35	350.00
	Publishing	L	articles	5	100	500
	Phenotyping manuals	L	books	30	20	600
	Scientific conference	L	person	4	800	3200
Subtotal: Visibility Plan (1-3 % total project budget)						5,850

Notes:

Indirect Costs (8.3 % of total budget)						41500

Notes: *provide indicative list of indirect costs to be included*

TOTAL PROJECT BUDGET	499,999.42

APPENDIX 5: DISBURSEMENT INFORMATION

Bank Name: JPMorgan Chase Bank, N.A.

Bank address: 277 Park Avenue, 23rd Floor
New York, NY 10172-0003,
Tel. 212-270-0619

Branch : New York

Country : **USA**

Beneficiary : CIMMYT

Account number: 949-2-603213

Account currency: USD

IBAN Code: ABA: 021000021

SWIFT Code: CHASUS33